



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

FORMATIONS OF THE MARION STAGE OF THE KANSAS PERMIAN.¹

By J. W. BEEDE, of Indiana University, Bloomington, Ind.

THE formations of the lower white Permian of Kansas have been well understood for some time. The upper part, largely on account of its poor exposures and relatively weak escarpments, has not heretofore been carefully worked out. The field-work of the Kansas and Oklahoma surveys during the past summer has thrown some light upon the importance and extent of these rocks.

The formations here considered lie above the disputed beds of the Meek, Swallow and others. They lie on the back slope of the Flint Hills and form a relatively fertile plain of little relief, which is in striking contrast to the rough topography of the Flint Hills to the eastward. The region studied lies in Dickinson, Geary, Morris and Marion counties of Kansas, and Kay and Noble counties of Oklahoma. Some of the formations may reach to the Nebraska line, though if they do they are quite thinned and changed in appearance. The maps represent field-work done in two localities near Marion, the type locality of the Marion stage, and the vicinity of Herington and north to the Smoky Hill river. The region about Marion and the immediate vicinity of Herington is my own mapping, and that lying north of Woodbine is the work of the Rev. John Bennett, the veteran stratigrapher of Kansas.

The rocks of the section were early described in a general way by Meek and Hayden, who traversed the region in two directions. Their section of the rocks of the Marion formation, as given in the general section of the region, is given below, the rocks numbered from the top down. We begin with No. 5, the first one coming within our region:

5. Bluish, red, light-yellow and gray clays, and soft claystones, with sometimes a few thin layers of magnesian limestone. In many places these clays have been traversed in every direction by cracks, into which calcareous and argillaceous matter have found their way, and subsequently became consolidated so as to form thin seams of yellowish impure limestone, which cross and intersect each other at every angle. The red clays are usually less distinctly laminated, contain more arenaceous matter, and often show ripple-marks on the surfaces. *Locality, bluffs along Smoky Hill river above the mouth of the Grand Saline.*..... 60 feet.

1. By permission of the State Geologists of Kansas and Oklahoma.

6. Light-gray, ash-colored and red clays, sometimes arenaceous, and often traversed by cracks filled with calcareous matter as in the bed above—alternating with thin layers and seams of gypsum. *Locality, near the mouth of the Smoky Hill [Solomon] river* 40 feet.
7. Rather compact amorphous white gypsum, with near the base disseminated crystals, dark colored, do. *Locality, same as last* 4½ to 5 ft.
8. Alternations of ash-colored, more or less arenaceous clays, with thin beds and seams of gypsum above; towards the lower part, thin layers of claystone, and at some places soft magnesian limestone. *Locality, same as last*..... 50 feet.
9. Rough conglomerated mass, composed of fragments of magnesian limestone and sandstone, with sometimes a few quartz pebbles, cemented by calcareous and arenaceous matter; variable in thickness and probably local. *Locality, south side of Smoky Hill river, ten or twelve miles below Solomon's Fork* seen, 18 feet.
10. Bluish, light-gray and red laminated clays, with seams and beds of yellow magnesian limestone, containing *Monotis hawni*, *Myalina perattenuata*, *Pleurophorus? subcuneata*, *Edmondia? calhouni*, *Pecten* undet., and *Spirigera* near *S. subtilita*; also *Nautilus eccentricus*, *Bakewellia parva*, *Leda subscitula*, *Axinus rotundatus*, and undetermined species of *Bellerophon*, *Murchisonia*, etc. *Locality, near Smoky Hill river, on high country south of Fort Riley, as well as on Cottonwood creek*, 90 feet.
11. Light-grayish and yellow magnesian limestone in layers and beds, sometimes alternating with bluish and other colored clays, and containing *Solemya*, a *Myalina* near *M. squamosa*, *Pleurophorus? subcuneata*, *Bakewellia parva*, *Pecten* undet., and a *Euomphalus* near *E. rugosus*; also a *Spirigera* allied to *S. subtilita*, but more gibbous, *Orthisina umbulacrum?*, *O. shumardana*, etc. *Locality, summit of the hills, near Fort Riley and above there; also seen on Cottonwood creek*... 25 to 35 feet.
12. Light-grayish yellow, rather granular magnesian limestone, containing spines and plates of *Archæocidaris*; a few fragments of small crinoid columns, *Spirifer*, similar to *S. lineatus*, but perhaps distinct; also same *Spirigera* seen in the beds above, *Orthisina shumardana*, *O. umbulacrum?* and *Productus calhounianus*. *Forms distinct horizon near summit of hills in vicinity of Fort Riley; also seen on Cottonwood creek*..... 7 to 8 feet.
13. Soft argillo-calcareous bed, apparently local. *Kansas Flaas*.. 5 feet.
14. Light grayish yellow magnesian limestone, containing mapy concretions of flint; also the same *Spirigera* found in the rocks above, *Productus norwoodi*, *P. calhounianus* with *Discina tenuilineata*, and an undetermined *Monotis*. *Fort Riley and below; also at Kansas Falls and on Cottonwood creek*... 38 feet.

This section, with the article from which it was taken, was published in the Proceedings of the Philadelphia Academy of Sciences, 1859, pp. 16, 17.

It is by no means a simple matter to correlate Meek and Hayden's section with our present knowledge of the section of this region. No. 22 of their section is pretty certainly the Cottonwood limestone. If this is the case, No. 18 would probably represent the Wreford limestone, and 16 may be the "main ledge" of the Fort Riley limestone. If this is true, then 15 would be the Doyle shales and 14 the Winfield limestone. This would make the upper part of the section correspond in a rough way to the Marion-Herington section which is to follow. The conglomerate No. 9 (Prosser's Abilene conglomerate) probably represents the layer referred to that name and horizon below occurring near Herington and Marion, though there are some lithologic differences in its make-up. This would leave 10 and 11 to represent the remainder of the rocks to the Luta limestone, No. 12. The general condition of the region, with sections, is given by Prosser.² Owing to the possible occurrence of low dome-like structures in the Permian rocks of this region we cannot correlate the sections near Salina and the Gypsum creek region with the eastern section until our detailed studies are carried over it.

In 1895 Prosser published the "Classification of the Upper Palaeozoic Rocks of Central Kansas."³ In this paper he divided the Permian rocks into "formations or stages." The formations of the Chase stage are now familiar to those acquainted with the stratigraphy of the region and will be omitted. The Marion was subdivided as follows:

PERMIAN.	MARION. (Prosser).	Variously colored shales and marls. Colored shales and marls alternating with beds of gypsum. Buff limestones and marls.
		<i>Abilene conglomerate.</i>
		Buff limestones which contain large <i>Lamellibranchia</i> .
		Grayish (?) limestones containing plenty of <i>Bakewellias</i> , near this horizon in some localities a concretionary limestone.
		Thin buff limestone with a few <i>Derbyas</i> .
	CHASE.	

2. Univ. Geol. Surv. Kan., II, pp. 56-64, 1897.

3. Jour. Geol., III, pp. 682-705, 764-800.

The portion of the tabulation containing the faunal characteristics and general thicknesses is here omitted.

In a tabulated section of the Kansas Permian rocks published later⁴ he did not differentiate the Marion formation, and let it, with the Wellington shales of Cragin, go to make up the Sumner stage of this author. I am in part at least responsible for this classification, and at the time doubted the advisability of subdividing the Marion. Much additional study has convinced me of the advisability of subdividing it, not to say the necessity of it. The Marion will have to go back to its original rank of a stage. The further discussion of the classification of the section into stages and larger groupings must await the working out of the paleontology of the beds.

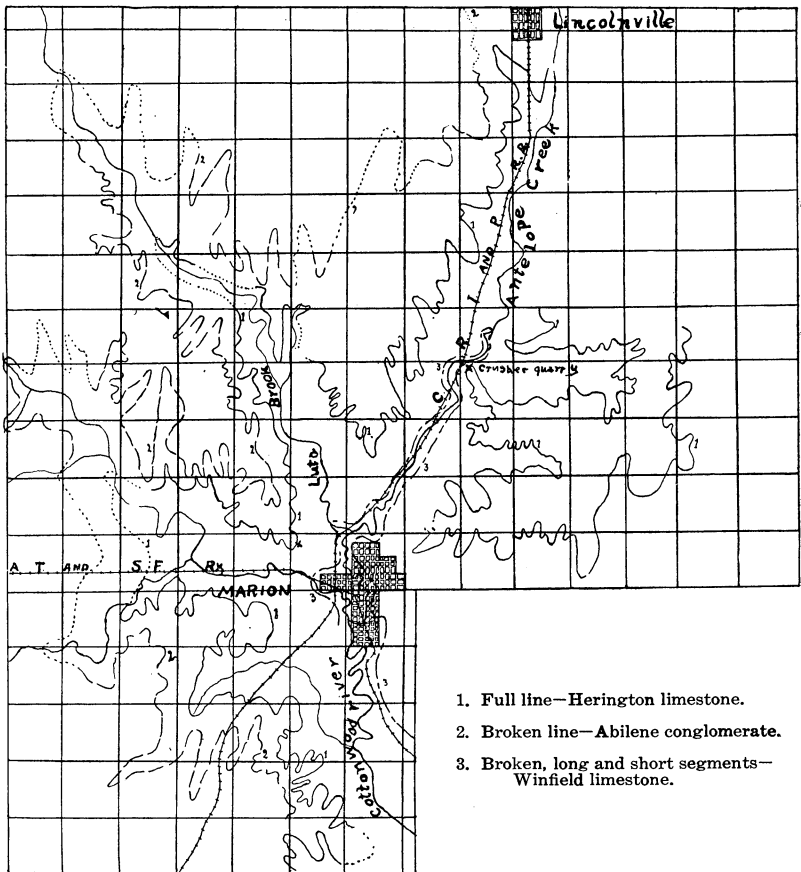
THE SECTION.

In order to give an idea of the section as a whole and the relation of the Marion stage to that of the Chase, the formations of the latter are enumerated from below upward: Wreford limestone, Matfield shales or formation, Florence flint, Fort Riley limestone, Doyle shales, and Winfield limestone. The first, third and fifth of these formations carry very large amounts of chert, which give rise to the term "Flint Hills" for the rugged country of their outcrop. The outcrop of the Marion rocks does not produce a rugged topography and the flint is nearly absent. The faunal distinctions between the two stages is quite as sharp as is the lithological or physiographical differences.

The Luta limestone.—Over a very considerable portion of central Kansas the Luta limestone forms the basal member of the Marion stage. It is well exposed in the city of Marion on Main street, east of the bridge, by the church. The limestone at the spring in the park is probably the Winfield. The Luta limestone as a whole is a more or less cellular, soft, gray stone thirty feet in thickness, with siliceous and other geodes scattered through it, and layers of more or less abundant chert concretions. The type exposure is taken at the crusher quarry about five miles northeast of Marion, on the Chicago, Rock Island & Pacific railroad. Here the total thickness is exposed, together with the top of the Winfield limestone. This section is given below. From observations at Arkansas City it seems that this limestone is very thin if it is not wanting there, and it is absent from the section east of Newkirk, Okla. It is exposed in a quarry along the railroad just north of Herington, and seems to be but ten or fifteen feet thick. It is

4. Prosser, Revised Classification of the Upper Paleozoic Rocks of Kansas, Jour. Geol., X, p. 718, 1902.

either wanting or very thin in Washington and Marshall counties in northern Kansas. It seems that it is thickest at Marion, thinning to the north and south. Nevertheless, it is present over a very considerable part of central Kansas region. It is so soft that it is of little value except for ballast. Its name is derived from Luta brook, which enters into Antelope creek just north of the city limits of Marion.



The following is the section at the crusher quarry, five miles northeast of Marion:

	Feet. Inches.	
7. Basal part of the Herington limestone.....	+	...
6. Yellow shales	15	0
5. Soft limestone, persistent	0	8
4. Green and yellowish shales.....	7	0

	Feet.	Inches.
3. Maroon shales.....	13	0
2. Limestone in thicker and thinner layers, some flaggy, cellular, geodiferous, and containing some bands of chert concre- tions.....	30	0
1. Winfield limestone(?) top layer, full of fine chert concretions (only upper part of layer shown).....	4	0

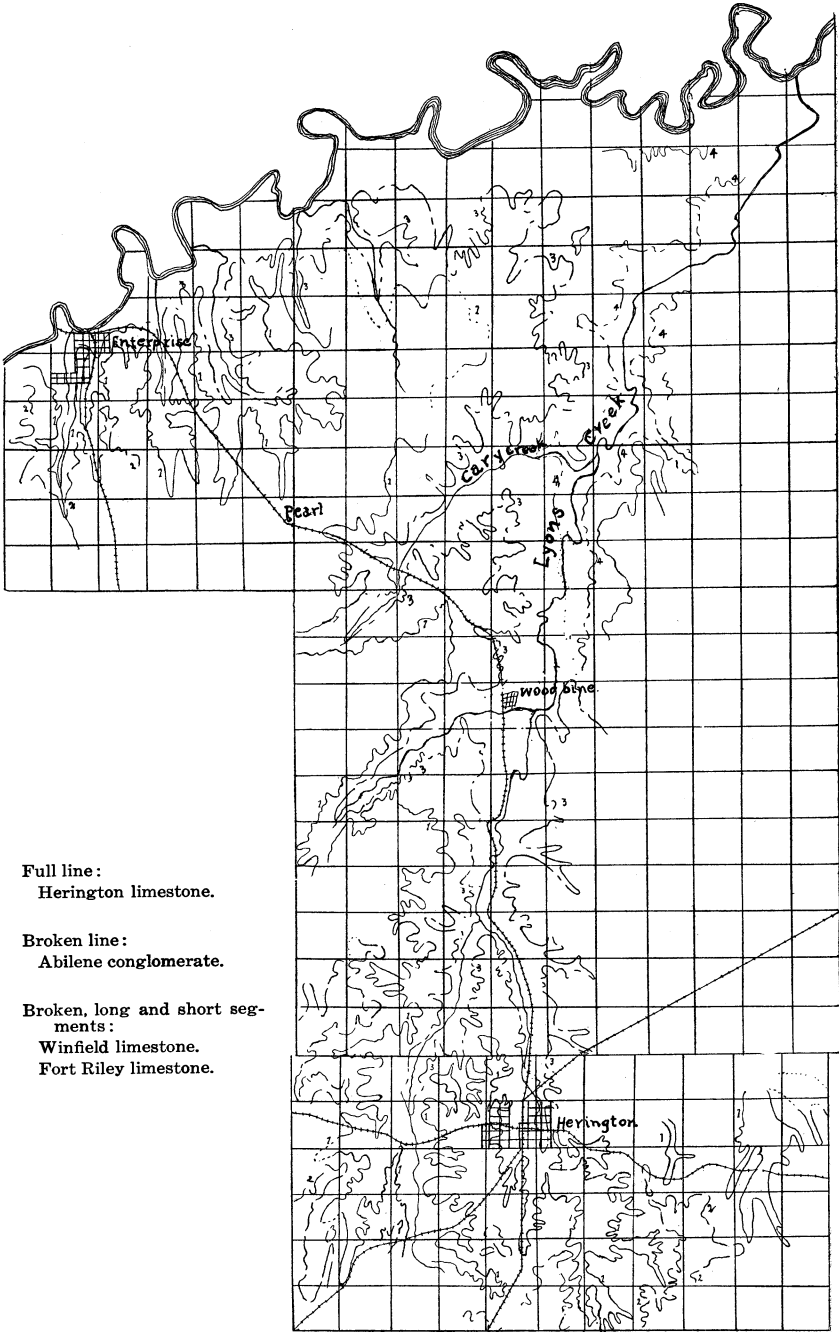
In this section No. 2 is the Luta limestone. Nos. 3 to 6 are the Enterprise shales, and No. 7 is the base of the Herington limestone.

Enterprise shales.—Over the Luta limestone are the Enterprise shales, shown in position about the town of Enterprise. The exposure in the section just given is the only one that I have seen showing the whole thickness in the central part of the state. They have been noted as far south as the vicinity of Uncas, in Kay county, Oklahoma, and are remarkably persistent and constant in their thickness. As will be seen from the section at the McCarty place, thin limestones occasionally come in near the top. These shales reach their maximum thickness, so far as now known, at Arkansas City, where there are forty-four feet of them.⁵

Herington limestone.—Though not very thick, the limestone is very extensive south of the Kansas river. It forms the elevations in the eastern and western parts of Herington. It is quarried northeast, west and southwest of Marion and at other places. It is known to occur at Enterprise, Herington, Marion, and without doubt is continuous with the limestone occupying the same horizon from west of Winfield through Arkansas City to Kay and Noble counties, Oklahoma. Its texture varies somewhat from place to place, even within very limited areas. In the bottoms of small valleys certain soft, geodiferous flaggy layers are sometimes found which are usually eroded away on escarpments, the softer material apparently resting upon the more resistant. The persistent layers are harder, of more of a buff shade, more massive, and very fossiliferous. Sometimes these fossils are very small species of pelecypods and occasionally they are rather large, perhaps occupying separate layers. This limestone, in all probability, is exposed in the top of the bluff north of Arkansas City (foot-note, *ante*), where it is about fifteen feet thick. It was correctly referred to the Marion by Prosser.⁶ As we proceed southward the texture of this rock becomes coarser. This is especially noticeable in its exposure two or three

5. Stratigraphy of the Eastern Outcrop of the Kansas Permian, Amer. Geol. XXXVI, p. 108, 1905.

6. K. U. Quart. VI, pp. 173-175, 1897. Doubt of this reference was expressed by Beede in the paper on "Stratigraphy of the Eastern Outcrop of the Kansas Permian," mentioned previously. The correctness of Prosser's reference was verified by Mr. Hooper under my direction.



miles east of Newkirk, Okla., where both this and the underlying Winfield limestone become arenaceous in their eastern edges. All these limestones, from the Wreford up, grade into the Red Beds, in about the latitude of Perry, Okla.

Section of the Herington limestone and the top of the Enterprise shale at the McCarty place, two miles northwest of Marion, Kan.:

	Feet.	Inches.
6. Limestones, thicker and thinner, buff, fossiliferous, and not very hard. Lower ones soft and massive, others somewhat porous and geodiferous. Near the top is a two-foot layer with myriads of small pelecypods; over this is another layer with larger shells.....	9	0
5. Shales, drab, weathering yellowish.....	11	3
4. Soft limestone, weathering shaly.....	1	0
3. Marly shales.six inches to	0	8
2. Thin bedded, soft limestone.....	2	0
1. Olive clayey, perhaps calcareous shales.....	0	6

No. 6 of this section is the Herington limestone. The exposures in the creeks two miles north and three miles west of Marion are probably above this outcrop, as no bottom to them could be seen, and the texture, as mentioned above was different. The total thickness near Marion may reach twelve or fifteen feet.

Pearl shales.—These shales are probably included in No. 10 of Meek and Hayden's section given above, as, perhaps, is the Herington limestone too. On account of the weakness of the overlying formation and its consequent recession from the outcrop of the limestone below, the exposures of this formation are few and small and do not show the nature of its entire thickness at any one place. It is known to be a succession of red, blue and green ones, though the dimensions of the individual layers are unknown. The estimated thickness of the Pearl shales in the vicinity of Herington and Marion is seventy feet.

The upper part of this shale is of the character of the "cracked" shales described by Meek and Hayden in their section already referred to. This structure continues up to the "conglomerate" at the top of the formation in such a way as to make it difficult to distinguish them in the region northwest of Marion, where there are no good exposures. Below this material are blue, red and drab shales in variable thickness to the limestone below. The term "Pearl shales" is used because that station on the Rock Island railroad is in the vicinity of their outcrop.

Abilene conglomerate.—The stratum to which this term is applied has not been correlated with certainty with the Abilene conglomerate, and the appellation is provisional until positive cor-

relation is made. However, while the texture of the stone varies somewhat from that of the original exposure, its distance from the base of the Marion is about the same and its nature is not all inconsistent with such a correlation. The conglomerate was first described by Meek and Hayden in No. 9 of the section quoted above. The name, "Abilene conglomerate," was first applied as a formation name by Prosser in "The Classification of the Upper Palæozoic Rocks of Kansas."⁷ It is a calcareous conglomerate, containing some sand and sandstone pebbles, near Abilene, where it seems to be considerably thicker than in the Herington-Marion region. In the field, no sand or sandstone was noted in the rock about Herington or Marion. It is a heavy, hard, perhaps dolomitic stone, composed of fragments of yellow, orange and gray masses firmly united in a light-gray cementing material. As previously noted, it rests upon the "cracked shale," which is rather thick in places and frequently not very dissimilar in appearance in poor exposures. It forms a weak escarpment which has been followed as far south as the divide between Marion and Peabody. Certain peculiar calcareous deposits south of Doyle creek near Peabody probably belong in the same horizon. It has not yet been recognized in Oklahoma.

This is the highest stratum of rocks in the Kansas white Permian making an escarpment of sufficient strength and continuity to be mapped over large areas. Above this horizon the limestones and gypsums appear to be more or less lenticular and discontinuous, so far as our investigations have gone. More detailed work may show that series of these occupy the same stratigraphic horizons and admit of approximate mapping, but it hardly seems so at present. In this respect the rocks of the Marion stage are quite distinct from those of the Wellington shales. So far as known, too, the Wellington shales are fossiliferous only in few localities and probably fewer horizons. For these reasons it seems best to limit the Marion stage to the formations herein described and shown on the accompanying maps, where only the limestones are shown.

7. Jour. Geol, III, p. 797, 1895.